Utilization of maternal health-care services in Peru: the role of women's education*

Irma T. Elo

Population Studies Center, University of Pennsylvania, 3718 Locust Walk, Philadelphia, PA 19104, USA

Abstract

This article explores the hypothesis that formal education of women influences the use of maternal health-care services in Peru, net of the mother's childhood place of residence, household socioeconomic status and access to health-care services. The findings are consistent with the hypothesis; both cross-sectional and fixed-effects logit models yield quantitatively important and statistically reliable estimates of the positive effect of maternal schooling on the use of prenatal care and delivery assistance. In addition, large differentials were found in the utilization of maternal health-care services by place of residence, suggesting that much greater efforts on the part of the government are required if modern maternal health-care services are to reach women in rural areas.

Findings from numerous studies of infant and child mortality conducted in developing countries over the last decade show a nearly universal, positive association between maternal education and child survival, a relation which has persisted in many societies even when the household's socioeconomic status has been held constant (Cochrane, O'Hara and Lesley 1980, Rutstein 1984, United Nations 1985, Cleland and van Ginneken 1988, 1989). As a result, the study of the pathways through which female schooling exercises its positive leverage has become of increasing interest to researchers in recent years (Cleland and van Ginneken 1988, Cleland and van Ginneken 1989, Barrera 1990, Streatfield, Singarimbun and Diamond 1990). It has been suggested, for example, that educating women alters the traditional balance of power within the family, leading to changes in decision-making and allocation of resources within the household (Caldwell 1979, Caldwell, Reddy and Caldwell 1983); that education modifies women's beliefs about disease causation and cure and thus influences both domestic child-care practices and the use of modern health-care services (Caldwell 1979, Caldwell, Reddy and Caldwell 1983); that schooling enhances the woman's knowledge of modern health-care facilities, improves her ability to communicate with modern health-care providers and, by increasing the value she places on good health, results in heightened demand for modern health-care services (Caldwell 1979, Schultz 1984, Caldwell and Caldwell 1988); and that maternal schooling reflects a higher standard of living and access to financial and other resources, because better educated women are more likely to marry wealthier men or because of their own increased earnings (Schultz 1984, Ware 1984).

*This research was supported by a National Institutes of Health Traineeship in Demography and a MacArthur Foundation Fellowship for the study of population and development. The data were made available by the Demographic and Health Survey Project and were collected by the DHS in conjunction with the Instituto Nacional de Estad'stica (INE) and Consejo de Poblaci—n. I am grateful to Michael Foster, and especially Andy Foster, for assistance with fixed-effects models. I also wish to thank Noreen Goldman, James Trussell, Sam Preston, Jane Miller, Lorenzo Moreno and an anonymous reviewer for comments on earlier drafts of this paper.

Because one of the principal objectives of primary health-care programs in developing countries is to improve child survival through increased utilization of preventive maternal and child health-care services, the question of whether mothers' education affects health service use is of considerable interest to health-policy makers. An improved understanding of the role played by female education can assist in the design of health interventions and, at the same time, advance our knowledge of the association between maternal education and child mortality. Evidence from previous research suggests that maternal education has a positive effect on the use of health-care services in Africa (MbackŽ and van de Walle 1987), some Middle-Eastern countries (Tekce and Shorter 1984, Abbas and Walker 1986), Asia (Akin et al. 1986, Wong et al. 1987, Streatfield, Singarimbun and Diamond 1990) and Latin America (Fern‡ndez 1984, Monteith et al. 1987).

Furthermore, both Barrera (1990) and Caldwell (1979, 1990) have argued that educated mothers are more likely than uneducated women to take advantage of modern medicine and comply with recommended treatments because education changes the mother's knowledge and perception of the importance of modern medicine in the care of her children. In a study of child nutrition in the Philippines, Barrera (1990) found that access to health-care services benefited children of educated mothers more than children of mothers with less schooling, a finding which suggested to the author that educated mothers were more likely to take advantage of available public health-care services than uneducated women. In Nigeria, Caldwell (Orubuloye and Caldwell 1975, Caldwell 1979) also found that educated women benefited more from available public health-care services than did uneducated mothers.

In contrast, Rosenzweig and Schultz (1982) view female schooling and health-care services as partial substitutes for information regarding knowledge of diseases, treatment of illness and child-care practices, and hypothesize that the effect of education on child health becomes less important as access to public health-care services improves. Presumably, in areas where such services are readily accessible, they are used by both educated and uneducated women, and thus the advantage conferred by schooling on health outcomes is narrowed. Using data from Colombia, Rosenzweig and Schultz (1982) found partial support for this hypothesis. Their results are consistent with the findings of other studies that have shown that differentials in child mortality by maternal education are less pronounced in countries with strong public-health programs, such as Costa Rica and Cuba (Behm 1979, Palloni 1981, Schultz 1990).

It is unlikely that the observed effects of maternal education on child-health outcomes simply reflects health knowledge and habits acquired in school, although they may play some role (Lindenbaum, Chakraborty and Elias 1989). Since the positive influence of maternal education on child health has been documented in a wide range of developing countries and in rural and urban areas of the same societies, where quality of schooling and teaching about healthy behaviours are likely to differ widely, persistent educational effects, found even at very low levels of schooling, seem more likely to reflect the development of cognitive skills, exposure to new ideas and 'modern' institutions (Caldwell 1990). Education could thus influence a woman's beliefs about disease causation and cure and the value she places on modern medicine.

We should note, however, that some portion of the observed effects of education may be spurious. Behrman and Wolfe (1987a, 1987b) have proposed that the association between female schooling and health outcomes may reflect not the influence of education, but the woman's childhood background, for which education serves as a proxy. The authors suggest that, in analyses without controls for the woman's childhood environment, education may serve as a proxy for human capital more generally, including health-related skills and habits acquired during childhood, and thus standard estimates of

education effects may overstate their impact on health outcomes. The authors found support for this thesis from a study of health outcomes in Nicaragua.

In this article we investigate the hypothesis that female schooling influences the use of maternal health-care services in Peru. We should note at the start, however, that our purpose is not to measure the effects of education on changes in attitudes or to model health-service demand in low-income countries *per se*, but rather to investigate the broad nature of the association between female education and the behaviour of the mother with respect to utilization of maternal health-care services. We are especially interested in examining the extent to which the relation between maternal education and the use of health-care services is confounded by the woman's childhood background, the household's socioeconomic status and access to health-care services; and whether female schooling retains a net effect on maternal health-service use, independent of such other determinants. The overall objectives of this study are to provide information for health-policy makers charged with the implementation of maternal health-service programs, and to enhance our understanding of the potential role played by health-service utilization in the association between maternal education and child survival. To examine these issues, we use data from the Peruvian Demographic and Health Survey conducted in 1986.

The setting

As one of Latin America's poorest countries, Peru has one of the highest child-mortality rates in the region. In 1980–85, for example, the probability of dying between birth and age five was 0.112 in Peru compared with 0.028 in Chile, 0.042 in Colombia, 0.060 in Brazil and 0.090 in Ecuador (Hill and Pebley 1989). Sharp regional and residential differentials characterize patterns of infant and child mortality within the country, where the Sierra (the Andean Mountain region) has the highest infant-mortality rate (110 per 1000) followed by the eastern jungle region (85 per 1000) and by the Pacific coastal area (56 per 1000 outside Lima and 34 per 1000 in Lima); rural infants are almost twice as likely to die as urban ones (IMR of 101 per 1000 in rural but 54 per 1000 in urban areas) (Instituto Nacional de Estad'stica 1988). In addition to residential variations in mortality, sharp differentials are also found by the educational level of the mother. In 1981–86, the infant-mortality rate of children of mothers with fewer than three years of schooling was 124 per 1000 compared with 22 per 1000 among infants of mothers with at least six years of education (Instituto Nacional de Estad'stica 1988).

Urban-rural and regional differentials in infant and child mortality reflect variations in living conditions, patterns of economic development and the distribution of health-care services within the country. Of Peru's three distinct geographic and ecological regions, the Pacific coastal area has been historically the most urbanized and industrialized (Mart'nez 1986, Wicht 1986). Relative to coastal areas, the Sierra, which houses close to 40 per cent of the population, is agricultural, rural and poor. Findings from a recent study on welfare distribution show, for example, that the rural areas of the Sierra are home to Peru's poorest households while relatively well-off families are concentrated on the coast, particularly in the Lima metropolitan area (Glewwe 1987). Finally, the forested eastern slopes of the Andes and the Amazon river basin make up the Selva which, largely owing to its geography and climate, has remained the least developed and populated region in Peru (Mart'nez 1986, Wicht 1986).

Despite recent governmental efforts to redistribute health-care facilities and to improve availability of preventive health-care services, access to modern medicine varies widely among the three regions and urban and rural areas. The Ministry of Health (MOH) is the principal provider of health-care services for Peru's poor population, but MOH services reach fewer than half of the Ministry's target population (Zschock 1988a). Rural areas are particularly unevenly and poorly served by the MOH, the only provider of modern medicine in rural areas, which places rural residents at a disadvantage relative to urban residents (Carrillo 1988, Zschock 1988a). In contrast, urban dwellers, especially those living on the coast, have access to another set of government-funded health-care services through Peru's

Social Security System, although it has been estimated that fewer than 20 per cent of the population have access to services funded by Social Security (Mesa-Lago 1988). There are also private health-care providers in Peru, who own a small number of hospitals and health centres, although again they operate mainly in and around Lima (Carrillo 1988, Costa and Vera la Torre 1988).

Regional and residential as well as cohort variations are also evident in women's educational attainment. Since the 1950s, educational reform has been an important component of governments' economic development policies, and this emphasis on education has led to a rapid increase in the number of schools and rising enrolments (Paulston 1972, Hay 1976, Fern‡ndez 1986, King and Bellew 1989a). The growth in attendance is reflected in rising levels of educational attainment among both men and women, although gender differences have continued to persist. These advancements have not been uniform across the country, however, as gains in rural areas have lagged behind those made in urban areas, where many of the new schools were located (King and Bellew 1989b). Given the skewed distribution of health-care services and the concentration of better-educated women in urban areas, we expect to find that much of the effect of maternal education on health-service utilization is confounded by access to services.

Data and methods

Source of data

The data used in this study come from the Peruvian Demographic and Health Survey (DHS) of reproductive-aged women carried out in September–December 1986 with the standard DHS questionnaire.[1] In addition to a retrospective fertility history and information on contraceptive use, fertility preferences, marriages, and the respondent's and her current partner's general background and work experience, the questionnaire included a maternal and child-health component which obtained information on the use of health-care services by the mother during pregnancy and delivery, childhood immunizations, and prevalence and treatment of diarrhoea for children born since January 1, 1981. A two-stage, cluster sampling procedure, designed so that the sample was self-weighing within each of Peru's 17 geographic domains, was used to select women to be interviewed. In total, 4,999 women were surveyed with the standard DHS questionnaire during Autumn 1986 (Instituto Nacional de Estad'stica 1988, Goldman, Moreno and Westoff 1989).

Our sample is based on last births born to ever-married[2] women during the five years prior to the interview date.[3] One reason for restricting analysis to ever-married women, as defined, is that information on family income was not collected in the DHS: husbands' education and occupation are important indicators of the household's economic status, and these data are available for ever-married women only; and no comparable information on household economic status is available for never-married women. Only the first child from each multiple birth was included in the sample, because

---

1 Two retrospective surveys of reproductive-aged women were carried out in Peru as a part of the Demographic and Health Survey (DHS) project in conjunction with Instituto Nacional de Estad'stica (INE) and Consejo de Poblaci—n. These two surveys included one that used the DHS standard questionnaire for high contraceptive prevalence countries (with minor modifications) and another that employed an experimental questionnaire designed to test a variety of methodological issues related to the measurement of levels and determinants of fertility, contraception, child health and infant and child mortality (see Goldman, Moreno and Westoff 1989).

2 'Ever-married' refers to all women who have been in either a consensual union or a legal marriage

3 Births included in this study come only from the five-year period prior to the survey, because the tape of the standard Peruvian DHS survey, used in these analyses, included health information only for children born during the 59 months immediately preceding the date of the interview.

information for all children of multiple births is identical with respect to maternal health-service use. The sample for this analysis includes 1,925 births.

Measurement of maternal health-care services

Two dependent variables were created from questions included in the maternal-health component of the DHS questionnaire on sources of prenatal care and delivery assistance for all live births that occurred within five years of the survey date.[4] Because of the central role played by modern health care in mortality reduction in developing countries (Caldwell 1990), the question of interest in this study is whether maternal education influences the use of modern health-care services. Thus, in both the analysis of prenatal care and assistance at delivery the dependent variable is coded 1 if the woman obtained services from a doctor or a trained nurse/midwife, and 0 otherwise.[5] Women had utilized the formal health-care sector more frequently for prenatal care than delivery assistance; mothers had received prenatal care for 60.1 per cent and delivery assistance for 54.9 per cent of last births born during the five years before the survey. This difference is largely due to patterns observed in rural areas, where women received prenatal care for a larger percentage of all pregnancies than deliveries. These proportions are consistent with the findings of the National Health and Nutrition Survey (ENSSA) conducted in Peru in 1984 (Instituto Nacional de Estad'stica 1986), and the results obtained from the DHS experimental survey carried out at the time of the DHS standard questionnaire (Goldman et al. 1989).

Analytic framework

Our model of maternal health-service use draws on the conceptual framework of health-seeking behaviour developed by Kroeger (1983). Based on an extensive review of the anthropological and sociomedical literature of health care, Kroeger (1983) proposed that determinants of utilization in developing countries could be grouped under three broad headings: (1) predisposing factors including age, sex, household composition and size, ethnic group affiliation and education; (2) characteristics of illness, expected benefits from treatment and beliefs about disease causation; and (3) characteristics of the health-care system, including cost and quality of care. According to this framework, education is only one of many factors influencing decisions concerning the utilization of health-care services.

In fact, maternal education is likely to be associated with many of the other determinants identified above. The educational level of the mother is, for example, likely to be related to access to health-care services and to financial resources available to obtain modern medicine, because educated women are more likely to live in urban areas and come from higher-income families. Furthermore, the educational level of a Peruvian mother depends on her birth cohort, childhood place of residence and ethnic group or native language, because of the rapid increase in educational opportunities during the last four decades, the faster expansion of schools in urban than rural areas and potential language barriers to

---

4 The DHS data do not permit us to control for the nature of the woman's pregnancy or her health endowments. It is possible, for example, that a woman seeks the services of modern health-care professionals simply because she has encountered difficulties during her pregnancy. In this case the effects of the covariates hypothesized to determine health-service use could be biased (Rosenzweig and Schultz 1983; Grossman and Joyce 1990). For example, if uneducated and poor women are more likely to have worse health endowments and are more likely to encounter difficulties during pregnancy and are thus more likely to seek modern health-care services than educated and wealthy women, then the estimated effects of maternal education and household socioeconomic status could be underestimated.

5 Other possible responses included untrained nurse (*auxiliar*) or birth attendant (*partera*); other; or no one. In the case of delivery assistance, family members were also included as a separate category. In Peru, *auxiliar* and *partera* are considered to be a part of the informal health-care sector.

schooling. These factors may also influence health-care behaviour and are likely to confound the association between female schooling and maternal health-service use.

We have distinguished a number of explanatory variables in addition to maternal schooling that may influence health-care behaviour and be associated with maternal education. Therefore, the analytic strategy employed here is to estimate a sequential set of equations based on a schematic framework, that takes into account the association between maternal education and other determinants, and that reflects the fact that the values of these variables are acquired at different stages of the women's life.[6]

Measurement of maternal education

It is possible to determine the number of years a woman had attended school from two questions included in the DHS. We have chosen to represent maternal education in four categories based on years and levels of schooling attained, instead of using the total number of years as a continuous variable. The four categories of female schooling are: no education, 1–3, 4–5, and 6+ years of schooling (Table 1). The middle categories divide primary-school education into two groups and the highest educational level indicates at least some secondary schooling. Relatively few women had received post-secondary education, and because of considerations of sample size, it was not possible to subdivide the highest education group.

As in most demographic surveys, questions in the DHS about women's education pertained to the time of the interview. This is not considered a serious problem, because all births included in these investigations occurred during the five years prior to the survey. Furthermore, the vast majority of women probably had also completed their education prior to marriage and childbearing.

Table 1
Characteristics of the sample used in the analyses of prenatal care and assistance at delivery, last live births to ever-married women 1981–1986, Peru DHS standard survey

Variable	Percentage	Variable	Percentage
Mother's education		**Husband's employment**	
None[a]	15.9	Agriculture[a]	37.5
1–3 yrs.	23.8	Skilled and unsk. manual	31.0
4–5 yrs.	20.9	Sales and service	15.2
6+ yrs.	39.3	Prof. and clerical	16.3
Childhood place of residence		**Durable goods** [b]	
City[a]	33.8	None[a]	14.6
Town	22.9	Small items	33.1
Countryside	43.4	Large items	52.2
Age of mother		**Piped water**	
< 20 yrs.[a]	11.0	No[a]	58.2
20–29 yrs.	68.3	Yes	41.8
30+ yrs.	20.7		
Language of the questionnaire		**Birth order**	
Spanish[a]	94.7	First births	18.4
Quechua/Aymara	5.3	2–3	33.6
		4–6	28.1
		7+	19.9

6 A similar approach was employed by Farah and Preston (1982) in an analysis of child mortality in Sudan.

Residence		**Prenatal care**[c]	
Lima[a]	24.1	No	39.9
Urban coast	17.8	Yes	60.1
Urban Sierra	9.9		
Urban Selva	4.7	**Assistance at delivery**[c]	
Rural coast	7.5	No	45.1
Rural Sierra	27.3	Yes	54.9
Rural Selva	8.7		
Husband's education			
< 4 yrs[a]	23.7		
4–6 yrs.	26.1		
7–11 yrs.	15.2		
12+	35.0		N = 1,925

[a] used as a reference category.
[b] durable goods: small items are either a radio or a bicycle or both; large items are a refrigerator, a television, a motorcycle, a car, or all or some of these items.
[c] prenatal care and assistance at delivery coded yes if a woman received care or assistance from a trained health professional (a doctor or a trained nurse/midwife).

Measurement of other explanatory variables

To account for the influence of the woman's childhood environment, we have included the woman's reported childhood place of residence as a categorical explanatory variable (Table 1). As an indicator of the mother's ethnic group affiliation we have included a variable denoting the language in which the interview was conducted which is the only way to distinguish between Indian and non-Indian women in the DHS. Because many Indians are bilingual we can identify only a relatively small number of births in this way, but these births are likely to come from the most disadvantaged women in the country.

The third background characteristic included is the birth cohort of the mother (Table 1). Because the availability of modern health-care services has increased in recent years, more younger than older women had access to modern medicine at the time when they began childbearing. It is quite possible that such experience has an effect on behaviour; for example, older women may be less comfortable with modern medicine and more reluctant to take advantage of available services than younger women. On the other hand, experience and skills acquired by older women should have a positive influence on the use of health services.

To measure health-service availability, a categorical variable was created from region and urban/rural residence (Table 1).[7] The inclusion of the residential covariate also enables us to examine the effect of health-facility distribution on the utilization of maternal health-care services by place of residence. Because the above measure of access does not account for variation in service availability within the seven broad residential categories, and thus provides only a relatively crude indicator of access to services, we also present results from a fixed-effects model, which takes account of unobserved differences between sampling units, including, but not limited to, service availability. Thus,

[7] We first ran separate models for urban and rural areas and then estimated models for pooled data. The pooling of data was not a significant restriction and we therefore present models for pooled data because the model is more parsimonious and results in greater precision of estimated coefficients. In addition to the survey of women, a community-level inquiry was carried out in Peru, but in rural areas only, to collect information on health-service availability. Unfortunately, the quality of the community-level data is rather poor, with information on distance and time of travel to nearest health-care facilities missing for a substantial proportion of births (Elo 1990). Because of the poor quality of the community-level data, we have not used them in this paper.

in addition to capturing access to services, the fixed-effects model also accounts for unmeasured social and cultural factors at the local level, which may be important in determining health-service use, net of the other variables included in the analysis. Because the educational level of the mother is associated with current place of residence, access to health-care services is likely to be a key intervening variable between female education and utilization of maternal health-care services.

Four proxy measures are used to control for family income and wealth. The first proxy is the woman's current husband's or partner's educational attainment, because education is closely associated with earnings of male workers in Peru (Glewwe 1987, Stelcner, Arriagada and Moock 1987). In addition to serving as a proxy for household income, husband's education also reflects tastes and preferences. The husband's attitudes towards modern medicine could, for example, influence the wife's decision of whether or not to seek modern health-care services. Caldwell has suggested that men with higher educational attainment may play a more important role in child-care decisions than men with less schooling (Caldwell 1990). The second proxy for the family's economic welfare is an index of husband's occupation; we use a standard classification of occupations employed by the World Fertility Survey (Table 1). The third measure is an index of durable goods with a categorization that reflects observed ownership patterns over different levels of household income in Peru (Glewwe 1987), and the fourth is a measure of housing quality (Table 1). Finally, maternal education itself is a determinant of the economic welfare of the household, particularly if the mother works. Preliminary analyses showed, however, that the mother's employment status was not a significant predictor of the utilization of maternal health-care services, and thus this variable is excluded from the models presented here.

Finally, birth order of the index child was included to capture both the woman's previous experience with pregnancy and birth, and family-size effects associated with health-service use, such as inconvenience of seeking health-care services when the mother has concurrent child-care responsibilities (Institute of Medicine 1988).

Equations and estimation

To assess the relative effects of our covariates of interest on maternal health-service use, we estimate a logistic regression. The model may be expressed as:

$$\ln[\pi/1-\pi] = \alpha + \beta X \qquad (1)$$

where π is the probability that the event occurs, α is the intercept and β is the vector of coefficients of the vector of covariates, X. In addition to estimating this model, we also estimate a fixed-effects logit model to eliminate the influence of unobserved differences between sampling units or clusters. The fixed-effects model takes account of differences in distance to health-care facilities among sampling units as well as other unobserved determinants of health-service use, which are homogeneous within clusters and which are not captured by the other covariates included in the analysis. The fixed-effects model has frequently been applied to the analysis of siblings (Griliches 1979, Behrman and Wolfe 1989, Geronimus and Korenman 1991, Hoffman, Foster and Furstenberg 1991), but to our knowledge has not been applied to control for community-level factors in the analysis of health-service utilization.

Let π_{ij} be the probability that an event occurs for a woman i (i=1,2) from a cluster j and that this probability is determined by a set of measured woman-specific characteristics, which may (Z_{ij}) or may not vary (X_j) among women in the cluster, and an unobserved cluster-specific effect (α_j):

$$\ln[\pi_{ij}/1-\pi_{ij}] = \alpha_j + \Gamma X_j + \beta Z_{ij} \qquad (2)$$

where Γ and β are the corresponding parameters of the vectors of covariates, X and Z. When the model is estimated without α_j, as in 'ordinary' logistic regression of equation (1), estimates of β may be

biased.[8] Comparisons of results obtained from 'ordinary' logistic regression with controls for our seven-category residential variable, and the fixed-effects model, allow us to test for the adequacy of controlling service availability by this residential covariate. The cluster-specific fixed-effect (α_j), is eliminated by first-differencing all variables between pairs of women in the cluster. In the subsequent analysis, the difference in the dependent variable is regressed on the differences in the explanatory variables. Note that by differencing all variables between pairs of women in the same cluster the effect of any variable that does not vary between women in the cluster (for example, α_j or region and urban/rural residence) cannot be estimated in this model.

The use of a fixed-effects model requires that we must first pair women within clusters. To do so we randomly selected pairs of women from each sampling unit.[9] Secondly, since it is impossible to distinguish the effects of characteristics unique to the cluster from the effects of the other covariates when women do not differ in the outcome of interest, only pairs of women who differ with respect to the outcome measure of interest can be included in the analysis (Chamberlain 1982). All pairs in which both women had an identical value for the dependent variable, are therefore excluded from the estimation of the fixed-effects logit model. Such exclusion leads to a reduction in the sample size, which can be quite substantial and may affect the precision of the estimated effects of the covariates. For the fixed-effects logit model our sample sizes are reduced to 214 pairs of women for the analyses of prenatal care and 169 pairs of women for analyses of delivery assistance.

The interpretation of the coefficients obtained from the fixed-effects logit model are the same as in the case of 'ordinary' logistic regression. We used the statistical package STATA to estimate all models. Three types of statistical tests are carried out: t-tests for testing the significance of individual coefficients (that is, for the net effects between each category and the reference category in the case of categorical covariates); global tests of significance, comparing fits of the sequential (nested) models; and the Hausman specification-test to examine significant differences between coefficients from the 'ordinary' logistic-regression model and the fixed-effects model (Hausman 1978).

Results

Maternal education

The bivariate effects of female schooling show a strong positive association between education and the use of maternal health-care services with the effects being somewhat stronger for delivery assistance than prenatal care (Model 1 of Table 2). Women with no education had received prenatal care for only 22.1 per cent of last births within five years of the survey while women with at least some secondary education had received care for 87.1 per cent, a relative odds of 23.57 (exp [3.16]). The comparable percentages for assistance at delivery were 13.4 per cent and 88 per cent, a relative odds of 47.47 (exp [3.86]) (Model 1 of Table 2).[10] There is no doubt, however, that these results are confounded by the woman's childhood background, access to services and the socioeconomic status of the household, and

8 The fixed-effects model captures a linear effect of unobserved community-level factors.

9 Note that if only one woman in a cluster had a birth within five years of the survey she would be excluded from subsequent analyses; 39 births were thus omitted. On the other hand, more than one pair of women from a cluster can be included

10 The unadjusted percentages reflect the percentage of women who used prenatal care or assistance at delivery without taking into account the effects of the other variables. The odds ratios are calculated by exponentiating the respective coefficient in Table 2. When a predictor is a dummy variable that takes on the values of 0 or 1, then exponentiating its coefficient yields the odds-ratio, the ratio of the odds of being in that category relative to the odds for being in the base (or omitted) category for that factor.

will be substantially attenuated when other determinants are incorporated in successively more complex models.

Model 2 of Table 2 estimates maternal health-service use as a function of the woman's background characteristics (childhood place of residence, birth cohort of the mother and ethnic background) in addition to her level of schooling. The introduction of the woman's background characteristics rather substantially attenuates the effects of maternal education at the highest level of schooling relative to the no education category, but there are smaller reductions at lower levels of education. Once the woman's background characteristics are held constant, the relative odds of receiving prenatal care for a woman with at least some secondary schooling relative to a woman with no education are reduced by 42.3 per cent from 23.57 to 13.60 (exp [2.61]), while the corresponding reduction for delivery assistance is 58.5 per cent, from relative odds of 47.47 to 19.69 (exp [2.98]). Thus, a portion of the unadjusted effect of maternal education clearly reflects the influence of the woman's childhood background, and in this sense is spurious. These results are consistent with the thesis proposed by Behrman and Wolfe.

Table 2
Logistic regression estimates (and z-statistics[a]): effects of maternal education, childhood residence, ethnicity and maternal age on prenatal care and delivery assistance

Covariate	Prenatal care		Assistance at delivery	
	Model 1	Model 2	Model 1	Model 2
Mother's education				
None[b]				
1–3 yrs.	0.86 (5.17)	0.81 (4.62)	1.02 (5.17)	0.89 (4.17)
4–5 yrs.	1.70 (9.94)	1.55 (8.24)	1.99 (10.19)	1.71 (7.80)
6+ yrs.	3.16 (18.08)	2.61 (12.70)	3.86 (19.15)	2.98 (12.76)
Childhood place of residence				
City[b]				
Town		-0.43 (2.61)		-1.04 (5.97)
Countryside		-1.17 (7.62)		-2.08 (12.55)
Age of the mother				
< 20 yrs.[b]				
20–29 yrs.		0.33 (1.85)		0.63 (3.23)
30+ yrs.		0.57 (2.68)		0.90 (3.84)
Language of questionnaire				
Spanish[b]				
Quechua/Aymara		-0.32 (1.24)		-1.72 (3.29)
Constant	-1.26 (9.15)	-0.69 (2.61)	-1.87 (11.15)	-0.80 (2.72)
	χ^2= 524.5 df=3*	χ^2= 606.3 df=8*	χ^2= 737.1 df=3*	χ^2= 968.7 df=8*

[a] z-statistic = absolute value of estimate/standard error. 1.96 and 1.64 are the critical values for significance at the 95% and 90% levels with a two-tailed test.
[b] reference category (captured by the constant term).
* χ^2 obtained by subtracting the deviance of the current model from the null model.

We hypothesized that access to services is a key confounding factor in the relation between female schooling and utilization of maternal health-care services. In Table 3, we present results from two

models which add controls for service availability to Model 2.. Model 3 controls for access to services by our seven-category residential variable, while the fixed-effects model takes account of unobserved differences in service availability among sampling units. The results from Model 3 (Table 3) show a further attenuation in the effects of maternal education on health-service use relative to the prior Model 2 (Table 2). For example, the relative odds that a woman with at least six years of schooling had received prenatal care compared to a woman with no education are now reduced to 8.33 (exp [2.12]), while the odds for delivery assistance are now 10.70 (exp [2.37]) (Model 3 of Table 3), compared to 13.60 and 19.69 obtained from Model 2, respectively. Moreover, the differences between women with no schooling and those who had received 1-3 and 4-5 years of education have also shrunk.

Table 3
Logistic regression estimates (and z-statistics[a]): effects of maternal education, childhood residence, ethnicity, maternal age and current residence on prenatal care and delivery assistance

Covariate	Prenatal care		Assistance at delivery	
	Model 3	Fixed effect	Model 3	Fixed effect
Mother's education				
None[b]				
1–3 yrs.	0.69 (3.72)	1.01 (2.23)	0.71 (2.92)	0.38 (0.79)
4–5 yrs.	1.30 (6.55)	2.00 (4.12)	1.41 (5.62)	0.90 (1.73)
6+ yrs.	2.12 (9.69)	2.48 (4.74)	2.37 (8.93)	1.61 (3.08)
Childhood place of residence				
City[b]				
Town	-0.03 (0.17)	0.33 (0.94)	-0.51 (2.61)	-0.07 (0.19)
Countryside	-0.33 (1.80)	-0.21 (0.59)	-1.01 (5.02)	-0.38 (1.10)
Age of the mother				
< 20 yrs.[b]				
20–29 yrs.	0.11 (0.57)	-0.35 (0.92)	0.31 (1.41)	0.16 (0.48)
30+ yrs.	0.33 (1.49)	-0.57 (1.20)	0.54 (2.03)	0.09 (0.20)
Language of questionnaire				
Spanish[b]				
Quechua/Aymara	0.13 (0.49)	-1.06 (1.52)	-0.90 (1.65)	-0.68 (0.77)
Place of residence				
Lima[b]				
Urban coast	-0.59 (2.85)		-1.69 (6.46)	
Urban Sierra	-0.67 (2.80)		-1.54 (5.25)	
Urban Selva	-0.83 (2.78)		-1.94 (5.68)	
Rural coast	-1.20 (4.78)		-2.24 (7.49)	
Rural Sierra	-2.16 (10.32)		-3.87 (13.94)	
Rural Selva	-1.97 (7.95)		-3.38 (10.75)	
Constant	0.39 (1.25)		1.33 (3.41)	
	χ^2= 751.4 df=14*		χ^2= 1286.9 df=14*	

[a] z-statistic = absolute value of estimate/standard error. 1.96 and 1.64 are the critical values for significance at the 95% and 90% levels with a two-tailed test.
[b] reference category (captured by the constant term).
* χ^2 obtained by subtracting the deviance of the current model from the null model.

The results from the fixed-effects model (Table 3), which captures unobserved differences between sampling units, further confirm the importance of maternal education on the utilization of maternal health-care services. In the case of prenatal care, maternal schooling had a somewhat more pronounced influence in the fixed-effects model than in Model 3, although only the difference for 4–5 years of education approaches significance (at the 10 per cent level) between Model 3 and the fixed-effects model. The results from the fixed-effects model for delivery assistance, on the other hand, show an attenuation in the effects of maternal schooling compared to the results from Model 3, although the two sets of coefficients do not differ from each other in a statistically significant way, except in the case of the highest level of schooling (at the 10 per cent level). The last modifier is new.

In Table 4 we present findings from our final model which takes into account the influence of the household's socioeconomic status and the woman's previous reproductive experience in addition to the covariates included in the previous models presented in Table 3. Maternal education retains a significant influence on the use of both prenatal care and delivery assistance in both Model 4, which includes our seven-category residential covariate, and in the fixed-effects model, although the effect is weakened by the inclusion of socioeconomic factors and the woman's previous reproductive experience. For example, the odds that a woman with at least six years of schooling received delivery assistance are reduced from 10.70 (Model 3) to 3.67 (exp [1.30]) (Model 4) compared to a woman with no schooling. The effects of the other education categories relative to the omitted category of no education were also reduced. Reductions in the effects of maternal education on delivery assistance are also found in the fixed-effects model when the household's socioeconomic status and birth order are added to the model (a comparison of results obtained from fixed-effects models presented in Tables 3 and 4). Although the education coefficients are no longer significant for the two lowest schooling categories in the fixed-effects model of delivery assistance (Table 4), we should note that the cross-sectional coefficients obtained from Model 4 and those obtained from the fixed-effects model do not differ in a statistically significant way.

In contrast to delivery assistance, the effects of maternal education (4–5 years) on prenatal care obtained from the fixed-effects model and from Model 4 are significantly different. The fixed-effects model shows a stronger influence of maternal schooling on prenatal care than Model 4, suggesting that our residential covariate provides an inadequate control of service availability in the case of prenatal care. Both variation in service availability among sampling units, and unmeasured social and cultural factors at the community level, which are captured by the fixed-effect model, may have confounded the relation between female schooling and the use of prenatal care in Model 4.

These results are consistent with previous analyses that have demonstrated the importance of maternal education in determining the use of health-care services in developing countries. Both cross-sectional and fixed-effects models yield quantitatively important and statistically reliable estimates of the positive impact of maternal schooling on the use of prenatal care and delivery assistance. Thus, there seems little question that the level of maternal education is an important indicator of the woman's propensity to seek the services of modern health-care professionals. However, if a woman's childhood place of residence fails to fully account for the influence of the woman's childhood background, in the absence of controls for the mother's parental home environment, the effects of education may reflect in part unobserved family characteristics.

Table 4

Logistic regression estimates (and z-statistics[a]): effects of maternal education, childhood residence, ethnicity, maternal age, current residence, socioeconomic status and birth order on prenatal care and delivery assistance

	Prenatal care		Assistance at delivery	
Covariate	**Model 4**	**Fixed effect**	**Model 4**	**Fixed effect**
Mother's education				
None[b]				
1–3 yrs.	0.49 (2.51)	1.06 (2.17)	0.44 (1.70)	0.25 (0.49)
4–5 yrs.	0.84 (3.80)	2.05 (3.91)	0.85 (3.03)	0.78 (1.34)
6+ yrs.	1.17 (4.66)	1.96 (3.40)	1.30 (4.22)	1.18 (1.96)
Childhood place of residence				
City[b]				
Town	0.12 (0.66)	0.48 (1.23)	-0.39 (1.94)	-0.11 (0.28)
Countryside	-0.04 (0.22)	0.04 (0.09)	-0.78 (3.74)	-0.31 (0.83)
Age of the mother				
< 20 yrs.[b]				
20–29 yrs.	0.22 (1.04)	-0.10 (0.22)	0.51 (2.05)	0.57 (1.33)
30+ yrs.	0.50 (1.97)	-0.15 (0.25)	0.91 (2.67)	1.09 (1.72)
Language of questionnaire				
Spanish[b]				
Quechua/Aymara	0.10 (0.36)	-1.04 (1.51)	-0.85 (1.56)	-0.18 (0.18)
Place of residence				
Lima[b]				
Urban coast	-0.49 (2.27)		-1.60 (5.85)	
Urban Sierra	-0.73 (2.94)		-1.57 (5.16)	
Urban Selva	-0.75 (2.40)		-1.82 (5.05)	
Rural coast	-0.52 (1.87)		-1.49 (4.51)	
Rural Sierra	-1.39 (5.73)		-3.12 (10.18)	
Rural Selva	-1.11 (3.97)		-2.47 (7.08)	
Husband's education				
< 4 yrs.[c]				
4–6 yrs.	-0.02 (0.12)	-0.32 (0.91)	0.08 (0.37)	0.28 (0.71)
7–11 yrs.	0.52 (2.50)	0.53 (1.15)	0.39 (1.59)	0.56 (1.29)
12+ yrs.	0.78 (3.46)	0.85 (1.82)	0.79 (3.05)	0.84 (1.80)
Husband's occupation				
Agriculture[c]				
Sk & unsk. manual	0.37 (2.23)	0.11 (0.26)	0.55 (2.88)	0.75 (1.83)
Sales and service	0.56 (2.67)	0.67 (1.52)	0.54 (2.26)	0.74 (1.56)
Prof., cler.	0.67 (2.70)	0.93 (1.73)	0.54 (1.98)	0.19 (0.35)
Index of durable goods				
None[c]				
Small items	0.27 (1.50)	-0.25 (0.63)	0.44 (1.91)	0.37 (0.84)
Large items	0.86 (4.25)	0.10 (0.23)	1.07 (4.45)	0.19 (0.42)
Piped water				
No[c]				
Yes	0.39 (2.43)	0.20 (0.42)	0.40 (2.24)	-0.09 (0.17)
Birth order[c]				
First births[c]				
2–3	-0.41 (2.13)	-0.72 (1.77)	-0.58 (2.45)	-0.60 (1.42)
4–6			-0.64 (2.49)	-0.79 (1.67)
7+			-0.81 (2.52)	-1.37 (2.31)
Constant	-0.69 (1.81)		0.20 (0.42)	
	χ^2= 846.0 df=24*		χ^2= 1370.1 df=26*	

[a] z-statistic = absolute value of estimate/standard error. 1.96 and 1.64 are the critical values for significance at the 95% and 90% levels with a two-tailed test.

[b] reference category (captured by the constant term).
[c] in the case of prenatal care birth order is coded as first births and second and higher order births.
* χ^2 obtained by subtracting the deviance of the current model from the null model.

Other determinants

The principal focus of this analysis is the impact of female schooling on the utilization of maternal health-care services. We can, however, obtain some perspective on the estimated education effects by examining the influence of the other determinants. Results from Model 2 (Table 2) imply that women who grew up in towns or the countryside are less likely to seek modern health-care services during pregnancy and delivery than women who grew up in cities. The findings from subsequent analysis, however, demonstrate that these effects are confounded by current place of residence and unobserved differences between sampling units. Once we take account of current residence the woman's childhood place of residence no longer retains an independent influence on prenatal care (Table 3). The effects of childhood place of residence are also substantially attenuated for delivery assistance, although they retain an independent influence in Model 4 (Table 4). However, these estimates are further attenuated and are no longer statistically significant in the fixed-effects model (Table 4), although the two sets of coefficients do not differ from each other in a statistically significant way. Of our other proxies for the woman's background characteristics, the effects of her ethnic group affiliation, captured by the language of the questionnaire, imply that non-Spanish speakers are less likely to seek maternal health-care services than Spanish-speaking women, although these effects do not retain statistical significance (Table 4).

Once we have controlled for the woman's other background characteristics and her education, results from Model 2 (Table 2) suggest that older women seem more likely to seek maternal health-care services than younger women. Such maternal age effects lose their significance for prenatal care, except for the highest age category in Model 4, although maternal age, at particular educational levels and birth order, has a stronger effect on delivery assistance (Table 4).[11] These results are consistent with a learning or experience hypothesis: it is possible, for example, that maternal age serves as a proxy for the woman's accumulated knowledge of health-care services and the value she places on modern medicine.

Women are more likely to seek maternal health-care services for first than higher-order births, controlling for maternal age and our other covariates (Table 4). Fern‡ndez (1984) interpreted similar findings to mean that women who have had more children tend to attach less importance to pregnancy and delivery than other women, particularly if they have not experienced difficulties with previous pregnancies. Birth-order effects, however, may also reflect the fact that having other children in the household is a factor in determining whether or not women seek maternal health-care services (Institute of Medicine 1988). Wong et al. (1987) also found that an increase in the number of children of preschool age in the family had a negative effect on prenatal-care utilization in urban areas of the Philippines. Such sibling effects could be caused by differences in attitudes of women with larger families, resource constraints, or by some other characteristics of larger households not measured in this analysis or in the Philippine study (Wong et al. 1987).

11 We tested whether the effects of maternal age varied by birth order by including an interaction term between maternal age and birth order in Model 4. The interaction was insignificant for delivery assistance, suggesting that birth-order effects are the same within each maternal age category. In the case of prenatal care, the interaction between maternal age and birth order showed a small overall net effect ($\chi^2 = 6.2$, df = 2). The positive effect of maternal age in the highest age group is somewhat stronger for first than higher-order births (results not shown).

From Models 3 and 4 we can also examine the effects of current residence on maternal health-service use. Despite the government's efforts to expand access to health-care services, our findings suggest that such efforts have been largely unsuccessful in reaching women outside the Lima metropolitan area, the coastal region more generally, and other urban areas. Although the effects of the residential covariate are somewhat attenuated when the socioeconomic variables are included in the model, residence retains a significant effect on maternal health-service use. The importance of residence is most clearly illustrated by the extreme differences in use between women living in Lima and the rural Sierra: the relative odds that a woman living in the rural Sierra received prenatal care or delivery assistance compared to a woman living in Lima are 0.25 (exp [-1.39]) and 0.04 (exp [-3.12]), respectively (Table 4).

Husband's education has a net effect similar to but weaker than mother's education (Model 4). The estimated effects of husband's schooling obtained from the fixed-effects model, although no longer statistically significant in most instances, also do not differ from the coefficients obtained from Model 4 in a statistically significant way. Husband's education is hypothesized to operate primarily as a proxy for economic well-being of the household, but at the same time, its effects are also likely to reflect attitudes toward modern medicine. The effects of other proxies for family income are also consistent with the theory that increased income has a positive effect on the utilization of modern health-care services. For example, women whose husbands work in agriculture appear the least likely users of modern health-care services (Model 4 of Table 4). Although the coefficients obtained from Model 4 and the fixed-effects model for husband's employment (Table 4) are not identical, and their significance levels have been substantially reduced in the fixed- effects model, none of the differences between the two sets of coefficients is statistically significant for either prenatal care or delivery assistance. Our other proxies for the socioeconomic status of the household (index of durable goods and piped water) lose their statistical significance and predictive power in the fixed-effects models of both prenatal care and delivery assistance (Table 4). The observed reductions most probably reflect the fact that the fixed-effects model takes account of unobserved differences between sampling units such as housing characteristics (water and sewerage facilities) as well as all other neighbourhood attributes (for example, overall levels of income).

Discussion

In this paper we have examined the hypothesis that female education influences maternal health-service use, net of the woman's childhood background, household's socioeconomic status and service availability. By investigating a sequential set of equations we also have explored the degree to which maternal schooling effects are attenuated by the other determinants also believed to influence the use of health-care services in developing countries. The focus on mothers' education was warranted on several grounds. Previous analyses of socioeconomic determinants of child health have found mothers' education to have a strong positive influence on child survival in most developing countries and, although father's education has also been identified as an important determinant in such analyses, maternal schooling has generally been more important. In 15 countries in Africa, Asia and Latin America, a 1985 United Nations study, for example, found the effects of maternal schooling on child survival to be on average twice as large as those of paternal schooling. We have documented stronger effects of mother's than husband's schooling on maternal health-service use. These results, undoubtedly, stem at least partly from the fact that women are the primary care-takers of children and therefore, mothers' attitudes and skills are especially important to the health of youngsters (Browner 1989, Schultz 1990).

The results from both the cross-sectional and fixed-effects model, controlling for service availability and the socioeconomic status of the household, confirmed the importance of maternal

education on the utilization of both prenatal care and delivery assistance. Although the differences in use among the four educational categories are narrowed substantially when the effects of all covariates are accounted for, important differences by the level of maternal schooling remain. At the same time, we also found that a portion of the unadjusted effect of maternal schooling reflected the woman's background characteristics and in this sense was spurious. These findings provided support for the thesis, proposed by Behrman and Wolfe, that education serves as a proxy for the woman's early environment. However, better measures of the woman's childhood background than those collected by the DHS are required to explore the extent of such confounding. Thus, it is possible that some portion of the education effect found here also reflects the woman's unobserved family background.

Our results with respect to the residential covariate are particularly instructive from the viewpoint of health-policy makers. Our findings confirm results of prior studies (see for example, Carrillo 1988, Zschock 1988a, 1988b) that have suggested that the very skewed distribution of health-care facilities in Peru is a major deterrent against the use of modern medicine, and that recent efforts to expand the availability of preventive health-care services have not been successful in reaching large segments of the rural population. We found large differences in the utilization of both prenatal care and delivery assistance between the Lima metropolitan area and other regions of the country, with women living in the rural areas of the Sierra and the Selva being particularly disadvantaged. Using coefficients obtained from Model 4 (Table 4) we have predicted the use of prenatal care and delivery assistance, according to maternal education in the Lima metropolitan area and in the rural Sierra (see below).[12]

These results clearly illustrate the importance of region of residence in determining maternal health-service use. For example, our estimates show that a higher percentage of uneducated women in Lima used both prenatal care and delivery assistance (62.0 per cent and 72.0 per cent) than women with the highest level of schooling in the rural Sierra (57.7 per cent and 41.1 per cent). In fact, simply equalizing educational levels in the two regions would do little to eliminate the estimated differences in use. For example, if educational attainment of women living in the rural Sierra were to increase to the levels observed in the Lima metropolitan area, holding all other factors constant, we would observe about a ten percentage-point increase in the usage of both prenatal care and delivery assistance in the region; from 43.3 per cent to 54.3 per cent in the case of prenatal care and from 27.2 per cent to 37.5 per cent in the case of delivery assistance,[13] levels far below those observed in Lima. Although our regional covariate is a rather crude proxy for service availability, the skewed distribution of health-care resources is likely to be the primary factor behind the above results, though unobserved factors, not measured by our other covariates, may also play a role. Thus, our results, taken together with findings from other studies, suggest that much greater efforts to redistribute health-care resources on the part of the government are required if modern maternal health-care services are to reach women in rural areas.

---

12 The adjusted percentages control for the effects of all determinants of health-service use included in Model 4 and are calculated as follows. First, a predicted probability for each birth in the sample is calculated based on the logistic-regression coefficients obtained from Model 4 in Table 4, and the assumption that all births belong to each education/residence category in turn, but at the same time retain their actual values with respect of all other explanatory factors. The adjusted percentage is then taken as the mean of the predicted probabilities of all births in the sample for each education/residence category. The overall percentage of use within each region is calculated as a weighted average of the predicted percentages with the proportion of women in each educational category as weights.

13 The predicted level of usage in the rural Sierra is calculated as the weighted average of the adjusted percentages by maternal-education category presented above for the rural Sierra with the distribution of women by educational level in the Lima metropolitan area as weights.

Table 5
Predicted percentages of women who sought prenatal care or delivery assistance

Mother's education	Lima		Rural Sierra	
	Prenatal care	Delivery assistance	Prenatal care	Delivery assistance
None	62.0	72.0	34.4	20.6
1–3 years	71.1	78.2	44.0	26.9
4–5 years	76.8	83.3	51.0	33.4
6+ years	81.6	87.9	57.7	41.1
Total	79.0	85.5	43.3	27.2

References

Abbas, A.A. and G.J. Walker. 1986. Determinants of the utilization of maternal and child health services in Jordan. *International Journal of Epidemiology* 15:404–407.

Akin, J.S., C.C. Griffin, D.K. Guilkey and B.M. Popkin. 1986. The demand for primary health-care services in the Bicol region of the Philippines. *Economic Development and Cultural Change* 34:755–782.

Barrera, A. 1990. The role of maternal schooling and its interaction with public health programs in child health production. *Journal of Development Economics* 32:69–91.

Behm, H. 1980. Socioeconomic determinants of mortality in Latin America. Pp.140–165 in *Proceedings of the Meeting on Socioeconomic Determinants and Consequences of Mortality, Mexico City 19–25 June 1979*. New York: United Nations, and Geneva: World Health Organization.

Behrman, J.R. and B.L. Wolfe. 1987a. How does mother's schooling affect family health, nutrition, medical care usage, and household sanitation? *Journal of Econometrics* 36:185–204.

Behrman, J.R. and B.L. Wolfe. 1987b. Women's schooling and children's health: are the effects robust with adult sibling control for the women's childhood background. *Journal of Health Economics* 6:239–254.

Behrman, J.R. and B.L. Wolfe. 1989. Does more schooling make women better nourished and healthier? Adult sibling random and fixed effects estimates for Nicaragua. *The Journal of Human Resources* 24:644–663.

Browner, C.H. 1989. Women, household and health in Latin America. *Social Science and Medicine* 28:461–473.

Caldwell, J. 1979. Education as a factor in mortality decline: an examination of Nigerian data. *Population Studies* 33:395–413.

Caldwell, J. 1990. Cultural and social factors influencing mortality in developing countries. *The Annals of the American Academy of Political and Social Science* 510:44–59.

Caldwell, J. and P. Caldwell. 1988. Women's position and child mortality and morbidity in LDCs. Paper presented to IUSSP Conference on Women's Position and Demographic Change in the Course of Development, Oslo.

Caldwell, J., P.H. Reddy and P. Caldwell. 1983. The social component of mortality decline: an investigation in south India employing alternative methodologies. *Population Studies* 37:185–205.

Carrillo, E.R. 1988. Distribution of health care facilities. Pp.101–132 in *Health Care in Peru: Resources and Policy*, ed. D.K. Zschock. Boulder: Westview Press.

Chamberlain, G. 1982. Analysis of covariance with qualitative data. *Review of Economics and Statistics* 47:225–238.

Cleland, J. and J. van Ginneken. 1988. Maternal education and child survival in developing countries: the search for pathways of influence. *Social Science and Medicine* 27:1357–1368.

Cleland, J. and J. van Ginneken. 1989. Maternal schooling and childhood mortality. *Journal of Biosocial Science* Suppl. 10:13–34.

Cochrane, S.H., D.J. O'Hara, and J. Leslie. 1980. The effects of education on health. World Bank Staff Working Paper No. 405. Washington, DC: The World Bank.

Costa, J.C. and J.C. Vera la Torre. 1988. Private health care financing alternatives. Pp. 79–97 in *Health Care in Peru: Resources and Policy*, ed. D.K. Zschock. Boulder: Westview Press.

Demographic and Health Surveys. 1987. *Core Questionnaire with Additional Health Questions for High Prevalence ('A') Countries*. Basic Documentation No. 3. Institute for Resource Development, Inc. Columbia, MD: Westinghouse.

Elo, I.T. 1990. Female education and the use of maternal and child health care services in Peru. Unpublished PhD. Dissertation. Princeton: Princeton University.

Farah, A.A. and S.H. Preston. 1982. Child mortality differentials in Sudan. *Population and Development Review* 8:365–383.

Fern‡ndez, H. 1986. Aspectos sociales y econ—micos de la educaci—n en el Perœ. Pp. 149-193 in *Problemas Poblacionales Peruanos II*, ed. R. Guerra-Garc'a. Lima: Asociaci—n Multidisciplinaria de Investigaci—n y Docencia en Poblaci—n.

Fern‡ndez, R. 1984. Analysis of information about mother-child care taken from fertility surveys in Latin America. Voorburg: International Statistical Institute. Unpublished manuscript.

Geronimus, A.T. and S. Korenman. 1991. The socioeconomic consequences of teen childbearing reconsidered. Working Paper No. 3701. Cambridge, MA: National Bureau of Economic Research.

Glewwe, P. 1987. The distribution of welfare in Peru in 1985-86. Living Standards Measurement Study, Working Paper No. 42. Washington, DC: The World Bank.

Goldman, N., L. Moreno, and C.F. Westoff. 1989. *Peru Experimental Study: An Evaluation of Fertility and Child Health Information (Final Report)*. Princeton: Office of Population Research, Princeton University; and Columbia, MD: Demographic and Health Surveys, Institute for Resource Development, Inc., and Westinghouse.

Griliches, Z. 1979. Sibling estimates, the beginnings of a survey. *Journal of Political Economy* 87:S37-64.

Grossman, M. and T.J. Joyce. 1990. Unobservables, pregnancy resolutions, and birth weight production functions in New York City. *Journal of Political Economy* 98:983-1007.

Hausman, J.A. 1978. Specification tests in econometrics. *Econometrica* 46:1251–1271.

Hay, G.A. 1976. *Educational Finance and Educational Reform in Peru* . Paris: International Institute for Educational Planning.

Hill, K. and A.R. Pebley. 1989. Child mortality in the developing world. *Population and Development Review* 15: 657–687.

Hoffman, S.D., E.M. Foster and F.F. Furstenberg Jr. 1991. Re-evaluating the costs of teenage childbearing. Unpublished manuscript.

Institute of Medicine. 1988. *Prenatal Care: Reaching Mothers, Reaching Infants*. Washington, DC: National Academy Press.

Instituto Nacional de Estad'stica. 1986. *Encuesta Nacional de Nutrici—n y Salud 1984*. Lima.

Instituto Nacional de Estad'stica. 1988. *Encuesta Demogr‡fica y de Salud Familiar (ENDES 1986). Informe General.* Lima.

King, E. and R.T. Bellew. 1989a. The effects of Peru's push to improve education. PPR Working Paper No. 172. Washington, DC: The World Bank.

King, E. and R.T. Bellew. 1989b. Gains in the education of Peruvian women in 1940's-1980's – patterns and explanations. Paper prepared for Conference on the Family, Gender Differences and Development, Yale University, New Haven.

Kroeger, A. 1983. Anthropological and socio-medical health care research in developing countries. *Social Science and Medicine* 17:147-161.

Lindenbaum, S., M. Chakraborty, and M. Elias. 1989. The influence of maternal education on infant and child mortality in Bangladesh. Pp.112–131 in *Selected Readings in the Cultural, Social and Behavioural Determinants of Health*, eds. John C. Caldwell and Gigi Santow. Canberra: Health Transition Centre, The Australian National University.

Mart'nez, H. 1986. Expansi—n demogr‡fica, migraci—n y desarrollo en el Perœ. Pp.119–148.in *Problemas Poblacionales Peruanos II*, ed. R. Guerra-Garc'a. Lima: Asociaci—n Multidisciplinaria de Investigaci—n y Docencia en Poblaci—n.

MbackŽ , C. and E. van de Walle. 1987. Socioeconomic factors and access to health services as determinants of child mortality. Paper presented at IUSSP Seminar on Mortality and Society in Sub- Saharan Africa, YaoundŽ.

Mesa-Lago, C. 1988. Medical care under social security: coverage, costs and financing. Pp.229–258 in *Health Care in Peru: Resources and Policy*, ed. D.K. Zschock. Boulder: Westview Press.

Monteith, R. S., C.W. Warren, E. Stanziola, R.L. Urzua and M.W. Oberle. 1987. Use of maternal and child health services and immunization coverage in Panama and Guatemala. *PAHO Bulletin* 21:1-15.

Orubuloye, I.O. and J.C. Caldwell. 1975. The impact of public health services on mortality: a study of mortality differentials in a rural area of Nigeria. *Population Studies* 29:259–272.

Palloni, A. 1981. Mortality in Latin America: emerging patterns. *Population and Development Review* 7:623–649.

Paulston, R. 1972. *Society, Schools and Progress in Peru*. New York: Pergamon Press.

Rosenzweig, M. R. and T.P. Schultz. 1982. Child mortality and fertility in Colombia: individual and community effects. *Health Policy and Education* 2:305–348.

Rosenzweig, M. R. and T.P. Schultz. 1983. Estimating a household production function: heterogeneity, the demand for health inputs, and their effects on birth weight. *Journal of Political Economy* 91:723–746.

Rutstein, S.O. 1984. Socioeconomic differentials in infant and child mortality. WFS Comparative Studies No. 43. Voorburg: International Statistical Institute.

Schultz, T.P. 1984. Studying the impact of household economic and community variables on child mortality. *Population and Development Review* Suppl. 10:215–235.

Schultz, T.P. 1990. Returns to women's education. Economic Growth Center Discussion Paper No. 603. New Haven: Yale University.

Stelcner, M., A-M. Arriagada and P. Moock. 1987. Wage determinants and school attainment among men in Peru. Living Standards Measurement Study. Working Paper No. 38. Washington, DC: The World Bank.

Streatfield, K., M. Singarimbun and I. Diamond. 1990. Maternal education and childhood immunization. *Demography* 27:447–455.

Tekce, B. and F.C. Shorter. 1984. Determinants of child mortality: a study of squatter settlements in Jordan. *Population and Development Review* Suppl 10:257–280.

United Nations. 1985. *Socioeconomic Differentials in Child Mortality in Developing Countries*. New York: UN Department of Social and Economic Affairs.

Ware, Helen. 1984. Effects of maternal education, women's roles, and child care on child mortality. *Population and Development Review* Suppl. 10:191–214.

Wicht, J. 1986. Realidad demogr‡fica y crisis de la sociedad Peruana. Pp. 7-115 in *Problemas Poblacionales Peruanos II*, ed. R. Guerra-Garc'a. Lima: Asociaci—n Multidisciplinaria de Investigaci—n y Docencia en Poblaci—n.

Wong, E.L., B.M. Popkin, D.K. Guilkey and J.S. Akin. 1987. Accessibility, quality of care and prenatal care use in the Philippines. *Social Science and Medicine* 24:927–944.

Zschock, D.K. 1988a. Introduction. Pp.3–14 in *Health Care in Peru: Resources and Policy*, ed. D.K. Zschock. Boulder: Westview Press.

Zschock, D.K. 1988b. The ministry of health: financing and coverage. Pp.197–227 in *Health Care in Peru: Resources and Policy*, ed. D.K. Zschock. Boulder: Westview Press.